

Short-Term Overconsumption of Sugars May Not be Associated with Depression in Mice

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Received: February 17, 2020; **Published:** March 09, 2020

Abstract

This study examined whether short-term overconsumption of sugar causes depression in mice by using a forced swim test (FST). A 3% glucose solution was fed to the mice in the experimental group, and the distilled water to the mice in the control group. After four weeks, the FST was carried out. Immobility times in the FST of the experimental group were not significantly different compared with the control group. Also, there were no significant differences in body weights or random blood sugar levels between the two groups. Based on these results, short-term overconsumption of sugars may not be associated with depression.

Keywords: *Depression; Glucose; Mouse; Forced Swim Test; Blood Sugar Levels*

Abbreviations

%; Percent; FST: Forced Swim Test; cm: Centimeters; °C: Celsius' Temperature; P: Probability; SEM: Standard Error of the Mean

Introduction

The number of people with depression is more than three hundred million, and the condition is associated with high mortalities [1,2]. Many researchers have suggested that depression is associated with various components contained in foods such as omega-3 polyunsaturated fatty acid and folate [3,4].

A lack of fiber intake for three or four weeks induced depression-like behavior in mice [5]. As dietary fiber delays the absorption of sugars, there may be an association between sugar intake and depression.

Several studies have investigated the association between long-term overconsumption of sugars and depression. Sanchez-Villegas, *et al.* (2018) reported that higher added sugars consumption was associated with depression risk [6]. Furthermore, men in the highest tertile of sugar intake from sweet food and beverages had a 23% higher chance of incidence of common mental disorder after five years [7].

However, there are few reports on the association between short-term overconsumption of sugars and depression.

Aim of the Study

The aim of this study is to investigate whether overconsumption of sugars for four weeks induces depression-like behavior in mice by conducting the forced swim test (FST).

Materials and Methods

Animals

In the present study, C57BL/6J male mice were bought from CLEA Japan, Inc. (Japan) and used. The mice were kept under a cycle of light condition for 12 hours (8 a.m. - 8 p.m.) and dark condition with access to feed, glucose solution and distilled water ad libitum. The experiments conducted in the present study were approved by the Animal Experiment Committee, Hirosaki University.

Diet

CE-2 was used as the diet in this study. The diet was bought from CLEA Japan, Inc. (Japan).

Experimental plan

The diet was given to all of the mice (10 weeks old). In addition, 3% glucose solution was given to the experimental group, and distilled water to the control group for four weeks. Thereafter, FST was performed, random blood sugar levels of the mice were determined, body weights of the mice were measured.

FST

FST was performed as described previously [5,8,9]. Mice were soaked individually in 10-cm-deep water (21 - 22°C) poured into a vertical acrylic cylinder (25 cm high and 10 cm in diameter) for a six-minute period. The time that mice spent immobile for the last four-minute period was measured. The immobile state of the mice was regarded as depression-like behavior [10]. Making minimal movements to keep the head above water or to remain afloat were also considered as immobility.

Statistical analysis

The Kolmogorov-Smirnov test was used to clarify whether the measured values per group conformed to the normal distribution. In case the values in both groups conformed to the normal distribution, the results were showed by mean values ± SEM, and analysis for differences between the groups were performed by t-test. In case the values in either group did not conform to the normal distribution, the results were shown by median, minimum and maximum, and P-value was computed by Mann-Whitney test. All of the P values were calculated by two-tail tests, and P values of < 0.05 were considered to be significant. All of the statistical analyses were carried out by using the Japanese version of Microsoft Excel 2019 for Windows (Microsoft Japan Co., Ltd., Japan) and Ekuseru-Toukei 2012 (Social Survey Research Information Co., Ltd., Japan).

Results and Discussion

There was no significant difference between the immobility times in the experimental group and those in the control group (Figure 1). The random blood sugar levels in the experimental group also were no significant different from those in the control group (Table 1). In addition, there was not significant difference between the body weights in the experimental group and those in the control group (Figure 2).

	Blood sugar level (mg/dl)		P-value
	Control group	Experimental group	
Median	118	121	0.58
Minimum	112	107	
Maximum	140	135	

Table 1: Influence of 3% glucose solution or distilled water consumption for four weeks on random blood sugar levels in mice.

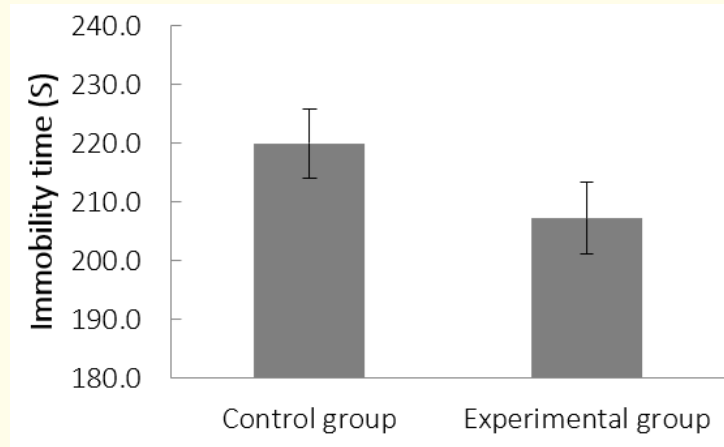


Figure 1: Influence of 3% glucose solution (Experimental group) or distilled water (Control group) consumption for four weeks on the period of immobility during forced swim test in mice. Data represent means \pm SEM. N = 5 - 6 animals per group.

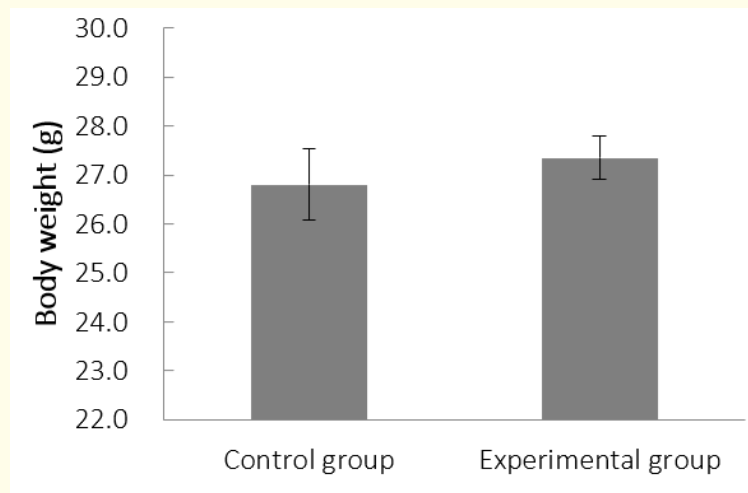


Figure 2: Influence of 3% glucose solution (Experimental group) or distilled water (Control group) consumption for four weeks on mice body weights. Data represent means \pm SEM. N = 5 - 6 animals per group.

Several studies have suggested that long-term overconsumption of sugars was positively associated with depression [6,7]. In the present study, the short-term overconsumption of sugars did not influence mice immobility time in FST.

In addition, a meta-analysis revealed that there were significant positive correlations between obesity and depression [11]. In this study, the short-term overconsumption of sugars also did not influence mice body weight.

From the results of this study, overconsumption of sugars for four weeks may not be associated with depression. However, further studies are needed to clarify the association between short-term overconsumption of sugars and depression.

Conclusion

Overconsumption of sugars for four weeks did not influence immobility times in FST, body weights, or random blood sugar levels. From the results, overconsumption of sugars for four weeks may not be associated with depression.

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Volume 15 Issue 4 April 2020

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